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How to Build a Solar Crop Dryer

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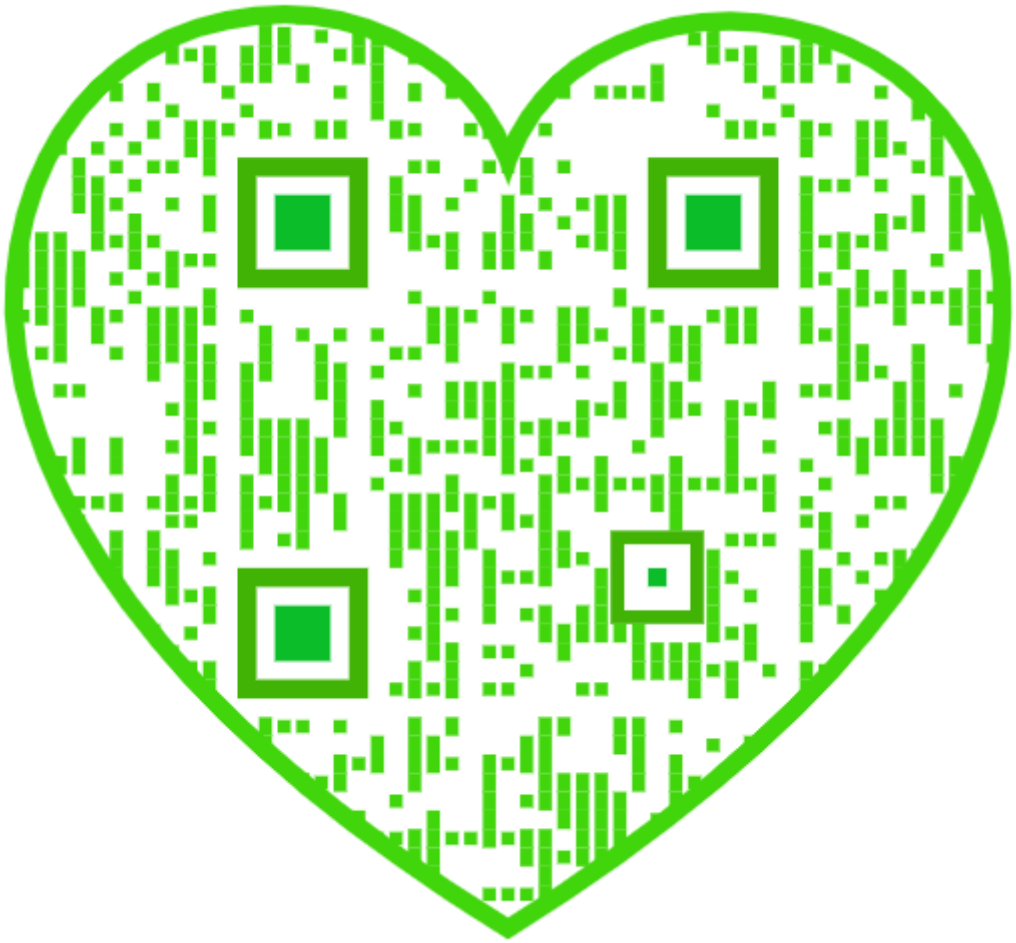
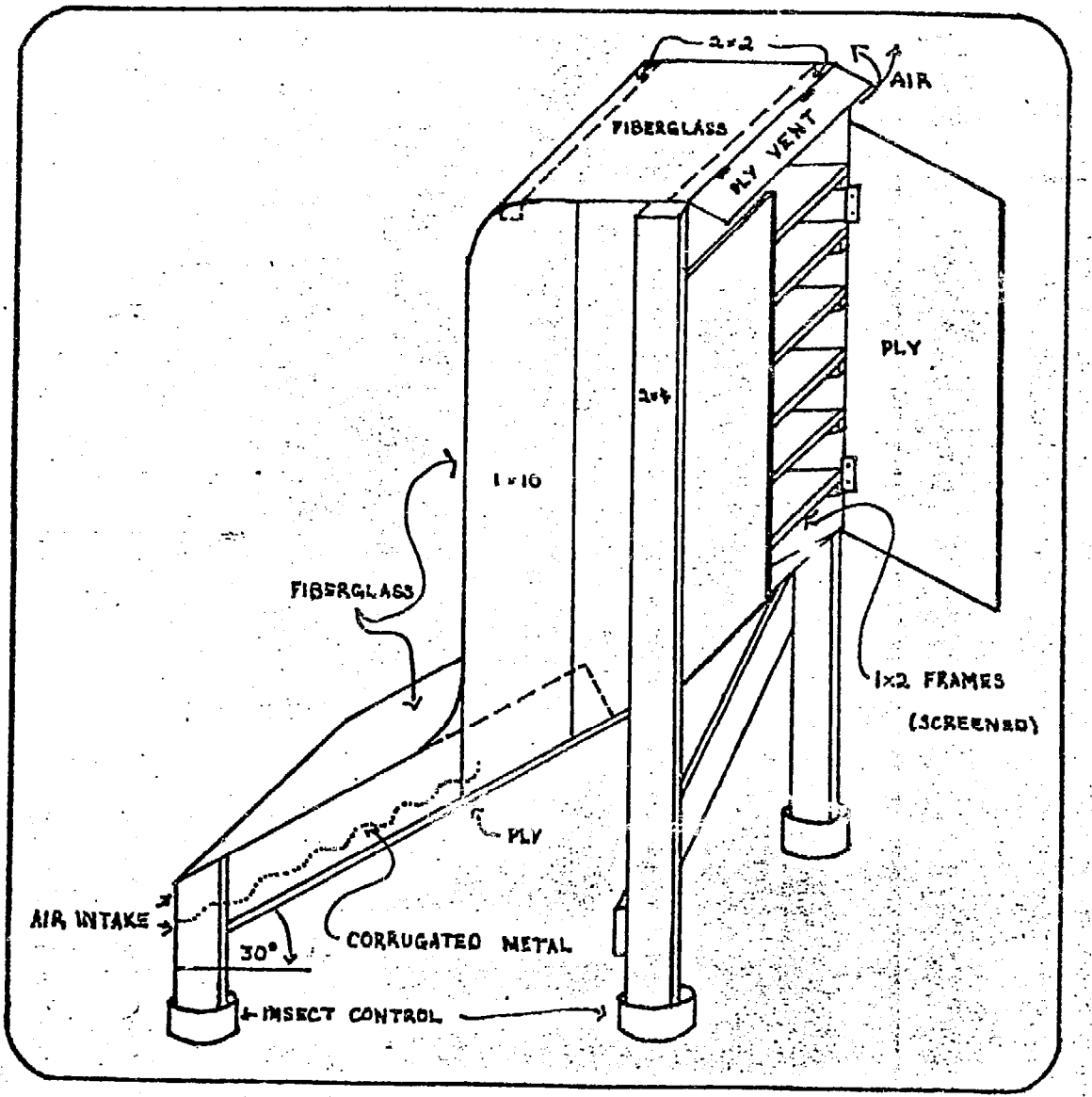


# How To Build A Solar Crop Dryer




NMSEA

NEW MEXICO SOLAR ENERGY ASSOCIATION

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Modern food drying offers nothing new to the process except increased convenience and control. Sun drying food is probably one of the oldest means of food preservation and, in times past, undoubtedly one of the more frustrating. Imagine the women watching in despair as the wind scattered her drying string bean crop ... or the one who came home late to find her drying peaches soggied by dew or rain -- that is, the ones the birds and insects had deigned to leave her ... or the one who served up dried apricots replete with a soft coating of dust.

The NMSEA, during five workshops throughout the State, has built several versions of a crop dryer design (see cover) based on a Peter van Dresser original. It operates on natural convection: air flows in at the bottom, is heated by a small, flat-plate collector (blackened corrugated iron) and heats up more as it rises through the sunny drying chamber. The food, which is sliced in ¼-inch to ½-inch sections, is placed on 4-foot by 1½-foot trays that are covered with an open-mesh nylon screen. This screen is superior to galvanized window screen since the wide mesh allows for better air circulation and the easily washable nylon does not contaminate the food with corroded zinc. Sunlight, striking the little collector, converts to heat. By the "greenhouse effect," the heat is largely trapped between the iron and the clear fiberglass cover, thus staying inside the dryer. An adjustable vent at the top maintains the heat building up in the drying chamber at about 120 degrees, while allowing adequate air flow to carry off moisture released by the food.

The vent adjustment is made at the hottest time of day, give or take an hour, and is made according to the temperature inside the dryer, which is regulated by a thermometer attached to a support out of the direct sunlight.

You need 10 square feet of drying rack per ½ bushel of food. This dryer has 36 square feet of tray space. The same dryer could accommodate twice as many trays. If a larger dryer is needed for commercial use, this design could be expanded from 4 feet wide to 8 feet wide. This module could then be duplicated to need.

Dried foods don't spoil because they don't have enough moisture to support bacteria or fungi. The water content of dried fruit is about 25 per cent. Vegetables need to be drier, since they cannot depend on the high osmotic pressure of their sugar content (a natural preservative) to keep out bacteria. The ideal temperature for drying is around 110 degrees F. Temperatures in excess of 140 degrees F. will result in enzyme breakdown, food discoloration and loss of vitamin C.

| | Vitamin | | | | |
|---|---|---|---|---|---|
| Fruit | A I.U. | B-1 Mgs. | B-2 Mgs. | C. Mgs. | Niacin Mgs. |
| Peach: | | | | | |
| Fresh | 1,330 | .02 | .05 | 7 | 1.0 |
| Dried | 3,900 | .01 | .19 | 18 | 5.3 |
| Pear: | | | | | |
| Fresh | 20 | .02 | .04 | 4 | .1 |
| Dried | 70 | .01 | .18 | 7 | .6 |

Very little food value is lost in the drying process. Overall vitamin content actually increases per edible portion since the portions become more concentrated after the water is removed.

The August 1976 issue of Organic Gardening recommends sheltering the food racks from direct sunlight to prevent excessive vitamin loss. For the record, however, the Himalayan Hunzas, considered to be among the healthiest people in the world, undaunted by ages of 100 years or more, live on a staple diet composed predominantly of sun-dried apricots and barley. They have a sweet-pitted,

almondy variety of apricot and they fold this pit into the dried apricot halves for a complete food. The Chinese also believe that the sun adds energy to foods, particularly herbs, which are almost entirely sun dried. Obvious exceptions are herbs with volatile oils, such as mint, which would lose their flavor in direct sunlight. The crop dryer could be used for such herbs if the cabinet were covered with a sunshade.

In northern New Mexico, every fall, hundreds of bushels of apples go to waste because people don't know what to do with them. Relatively few apples are of commercial quality and there is just so much cider one can make with a home cider press. What do to? Dry them! Drying, like canning, but involving less work and fuel, takes advantage of the low prices of seasonal crops. One of the advantages of drying is the 75 per cent decrease in volume.

For what it can do, this dryer is well worth the cost of materials (about $60.00) and the time you spend building it.

Have fun and Bon Apetit!

## MATERIALS

| Wood Size | Amount | To Make |
|---|---|---|
| 1" x 1" (or 1" x 2") | 4 - 8' | 12 frame supports 18" long. Vent screen mounts, 48" long. |
| 1" x 2" | 10 - 8' | 12 frame ends 18" long and 12 frame sides 46" long, collector ribs. |
| 1" x 4" | 1 - 12' | 2 - 45" collector sides; |
| 1" x 10" | 2 - 10' | Sides |
| 2" x 2" | 1 - 8' | 2 46½" upper cross braces (approximate measurement, depends on thickness of 1"x10's |
| 2" x 4" | 2 - 8' | Legs |
| Plywood | ½" x 4' x 8' | Exterior grade |
| Lattice or moulding | 60', ¼ x 1" | Holds screens on frames |

| Hardware Item | Amount |
|---|---|
| "scotch joints" corner braces | 50 |
| nylon or fiberglass screening | 6 - 18" x 45" |
| Lascolite, Glasteel, or Kalwall flat fiberglass sheets | 4' x 8' 4" |
| primer paint | ½ pint |
| black flat exterior paint | ½ pint |
| paint thinner | 1 pint |
| 3/4" brads | 120 (about) |

| Hardware Items (continued) | Amount |
|---|---|
| thin galvanized nails (these are the same size as plasterboard "blue nails" but are galvanized -- if you can't find them, blue nails will do.) | ½ pound |
| 4-penny nails, cement coated | ½ pound (to nail 1 x - to 1 x - ) |
| 6-penny nails, cement coated | ½ pound (to nail 1 x - to 1 x - ) |
| 10-penny nails, cement coated | ½ pound (to nail x x - to 2 x - ) |
| 12-penny nails, cement coated or 4 - 2¼" wood screws | ¼ pound (to nail 2 x 2 cross braces) |
| metal diagonals, 4" | 2 |
| small barrel bolt | (to close doors) |
| hook and eye | (to latch one door to bottom ply) |
| butt hinges, 3/4" x 3" | 4 (doors) |
| hinges, 1" or 2" (small) | 2 (plywood vent) |
| corrugated iron (26" wide) | 45" |
| screws, 3/8" | 18 |
| window screen | 11" x 4' |

| Tools Needed | |
|---|---|
| crosscut saw | plane |
| Skilsaw (optional) | mitre box (frame corners) optional |
| hammer | thermometer (to 130 degrees F.) |
| metal shears (corrugated metal and lascolite) | screw driver |
| sand paper | square |
| tape measure | keyhole saw (curves) |
| paint brush | 3/4" chisel (mortise hinges) |

# PROCEDURE

PREPARATION: Paint corrugated iron with primer and flat black paint; let dry.

1 SIDES OF DRYER: Take each 1 x 10, square the end, and measure 48½" along one edge. Use the supplied angle template to measure 60 degrees and cut so the short edge is 48½" long. Then measure the long edge A, Figure 1, and mark it off on the short edge of the remaining piece of 1 x 10. This gives you $A^1$. (See Figure 1.) Square and mark the board. Use the supplied curve template to round the corner at B. Cut the curve first with a keyhole saw or sabre saw,

complete the cut with a crosscut saw and save the remnant, "C", for later. If you now place edge "A" next to "A'", you have one side of the dryer. (See Figures 1 and 2).

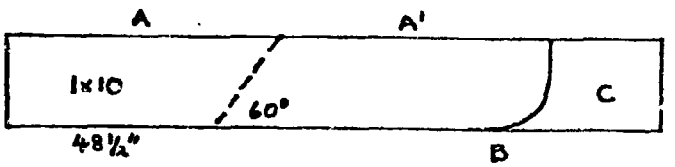
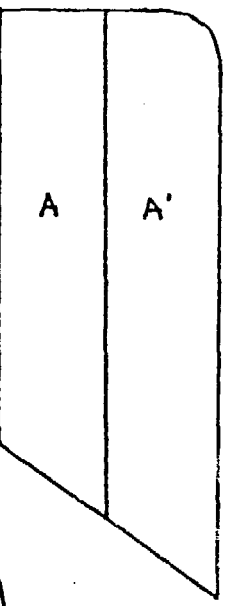



Figure 2

Figure 1




**2** :SIDES OF COLLECTOR: Mark off 40" on the 1 x 4, mark off 60 degrees so the short edge is 40" long. Cut. Duplicate this piece by using it as a template on the remaining 1 x 4 piece. (See "B", Figure 3). Nail the 1 x 4's to the 1 x 10's as shown, so that the bottom (long edge) of the 1 x 4 is flush with the angle cut of the 1 x 10's and makes 48" from the tip of the 1 x 4 to the edge of the 1 x 10. Note: the 1 x 4 is nailed on what will be the "inside" of the dryer, so when the second 1 x 4 is nailed to the second set of 1 x 10's the resulting configuration will be a mirror image of the first.

**3** :TRAY SUPPORTS. If you want six trays, cut 12 tray supports 18" long. Nail with 4 nails each to the 1 x 10's, spaced evenly. Leave 6" at the top for the vent. (Figure 2). Otherwise, nail as many tray supports as there will be trays (up to eleven) on each dryer side.

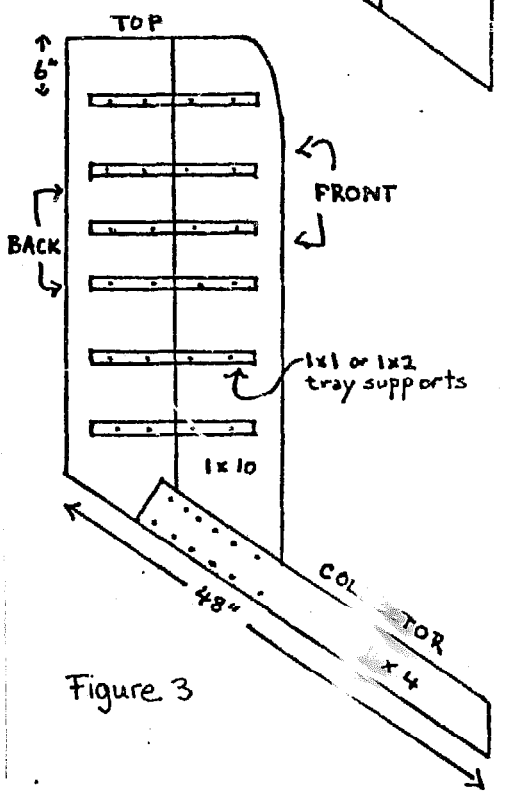



Figure 3

**4** : DOORS, VENT AND BACK. Mark off 48" on the plywood, square off and cut. (See "A", Figure 4). Then mark a 5" strip along one end of one square piece and saw off. (See "B", Figure 4). Then divide the remaining 48" x 43" piece in half so each piece is 24" x 43". These are the doors. (See "C", Figure 4)

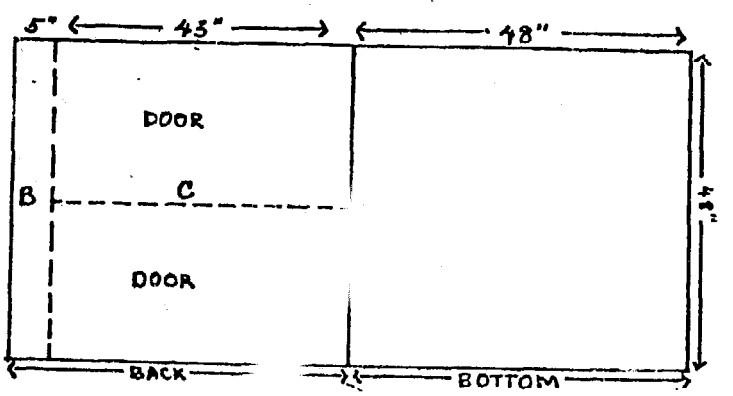



Figure 4

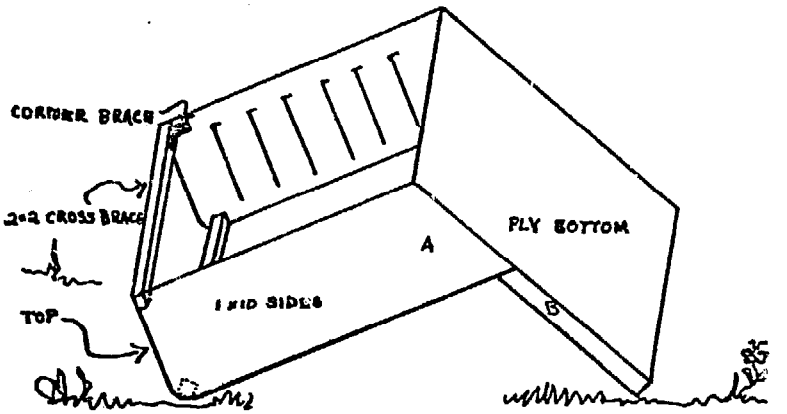



Figure 5

**5:** ASSEMBLING BODY: Turn the sides so the 1 x 4's and the curved corners touch the ground, so the sides are 4' apart. Place the 48" x 48" ply on the 1 x 4 and the 1 x 10 edges so that is is flush with the 1 x 10's (A) and overhanging the 1 x 4's by 3/4", (B).

The ply should not extend over the back edge of the 1 x 10's. Place a straight edge on the top of the 1 x 10's and bring the ply up to it (Figure 6). Nail in place with 10-penny cement-coated nails.

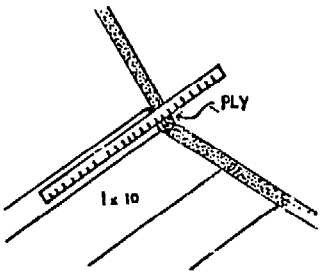



Figure 6

**6:** BRACING: Attach 2 x 2 cross braces, 46½" long to top front and top back 1 x 10's with two 12-penny nails each end (or 2½" wood screws). Front cross brace is in curve C, Figure 5. Screw on corner braces (Figure 5).

**7:** LEGS: Cut two 78" lengths from the 2 x 4's and nail with 10-penny nails to the back 1 x 10's, ½" from the back edge. This allows the door to open out (Figure 7). Front legs are 11" long in the front, cut off at 60 degrees and nailed to the front angle of the 1 x 4. Notch 3/4" x 4" strip of the plywood to let 2 x 4 sit flush on 1 x 4 (A, Figure 8). Measure 11" for the front legs and cut at 60 degrees so the short edge is 11". Nail front legs to the 1 x 4 with 10-penny nails.

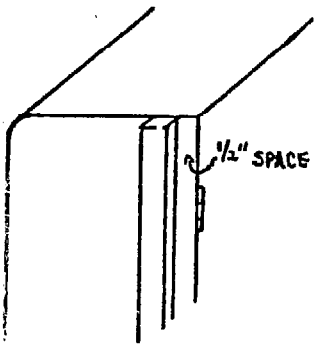



Figure 7

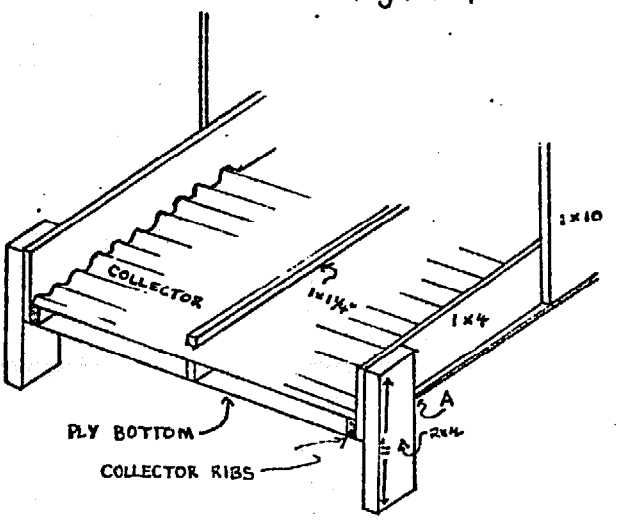



Figure 8

**8:** COLLECTOR PLACEMENT: Cut three 45" collector ribs from the 1 x 2 stock. While the dryer is still down, nail through the plywood into the 1 x 2 collector ribs with 8-penny nails. Also nail side collector 1 x 2 ribs to 1 x 4 collector sides. Place the corrugated metal that has been primed and painted black onto the 1 x 2's and nail in a few places with 6 penny nails. Then nail down the 1 x 1¼ (that was ripped from a 1 x 2) through the corrugated metal into the middle 1 x 2. (See Figure 8).

**9:** CURVE: Now stand the dryer up on its legs. It needs a curve to join the vertical 1 x 10 edges to the collector 1 x 4's. Take the pieces, C, from step 7 and cut them to fit the curve between the 1 x 4's and the 1 x 10's. (Figure 9.) Nail them on with 4-penny nails.

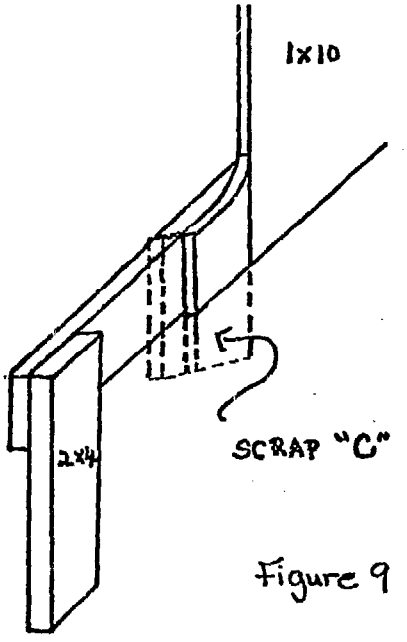


Figure 9

**10:** FIBERGLASS: Measure the entire length of the front of the dryer, starting from the 1 x 4 corner A, Figure 9, up the edge, up the curved piece cut in Step 9, up the front edge of the 1 x 10's, over the upper curve across the top of the 1 x 10's, to the back corner. Add 1" for overhang. This is the length of the fiberglass. Square it off and cut it with metal shears. Nail the fiberglass to this whole edge by laying the dryer on its back and fitting the fiberglass to the top so there is 3/4" of overhang at the back. Start nailing with the thin galvanized nails in the middle of each front 1 x 10. Work both sides evenly so there are no buckles in the fiberglass. Nail down the center brace of the collector and the back 2 x 2.

**11:** SCREENING: Screen the front air intake (bottom front) by stapling the screen to a 48" strip of wood moulding. Nail this to the 1 x 1¼ and the 1 x 4's so that it is snug to the fiberglass. Staple the screen to the 1 x 4 ends and the plywood.

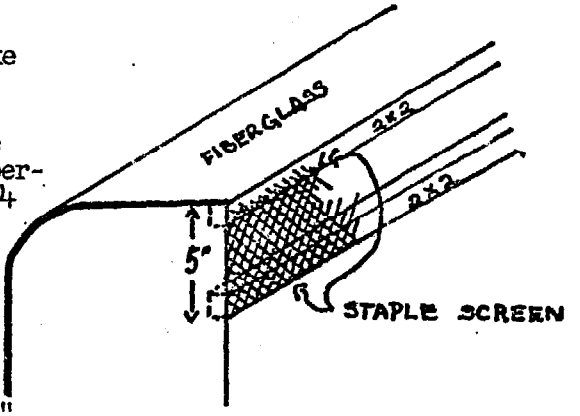


Figure 10

**12:** SCREENING VENT OUTLET: Staple 6" x 48" of screen along the edge to a 46½" long 1 x 2, nail the screen, facing back. (See Figure 10.) Staple the screen to the 2 x 2 and the 1 x 10's.

**13:** HINGES: Hinge the "vent" ply B, Step 4, to the 2 x 2 so that the upper edge is ½" from the fiberglass. Then hinge the doors so they fit snugly to each other and to the vent. Use ½" screws into the plywood. Mortise the hinges into the ply and into the edges of the 1 x 10's.

**14:** FRAMES FOR DRYER RACKS: Measure interior dimensions of dryer if your lumber is not standard dimensions. For standard dimensions, the frames will be 18" wide and 46" on the long side. Cut 12 pieces of each of these lengths with 45 degree angle cuts. Use a mitre box if precise power tools are not available. (Figure 11.) Join corners with "scotch joints" or equivalent above and below while squaring the corner with a framing square.

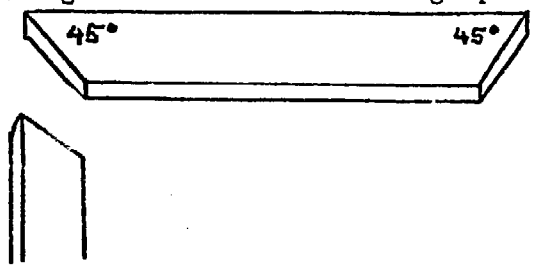



Figure 11

**15:** SCREENING AND FINISHING: Attach screen so it is well stretched with wood moulding or lattice and 3/4" brads. Install in dryer.

Attach eye and hook on ply door (inside dryer) where ply is most warped out.

Attach barrel bolt on outside of doors. Use remainder of 1 x 4 to make a diagonal on the back 2 x 4 legs. If you want to protect against crawling insects by inserting legs into water-filled cans, allow for the height of the can when you measure the diagonal (see main diagram). If you use varnish, linseed oil, or wood preservative, it may affect the taste of your dried food.

Mount a thermometer on the shady side of the front 2 x 2.

## TO OPERATE

1. Orient so the front is facing due south.

2. Adjust the vent opening so thermometer does not rise above 130 degrees F. at 1 to 2 p.m.

3. Remove trays to a convenient place to load with food to be dried.

4. Clean and cut food into sections ¼" thick (experiment -- some dryers dry peach and pear halves even).

5. Do not overdry fruit or meat to hardness. It should still be a little leathery. One to three average sunny days.

6. Dry vegetables, mushrooms, herbs, or starchy foods thoroughly. Store in sealed containers. Some herbs (with volatile oils) require shading during the drying.

7. Fruit leather: blend fruit in an electric blender to a creamy consistency and spread out on glass or cellophane that has been spread on the screen. The glass or cellophane should not cover too much of the screen to prevent air circulation. For instance, 10" squares of waxpaper is good. The fruit cream should be about 3/8" thick and will dry down to 1/8" or less.

8. Experiment with "chicos," surplus bread, or any other food that needs to be preserved.

## NEW MEXICO SOLAR ENERGY ASSOCIATION

Feel free to use this manual as you would a recipe. The sizes can be varied as needed, glass from old windows can be used; recycled lumber works fine. We would recommend that you seal the wood surfaces, due to the tremendous amount of moisture released during the drying process

For commercial use, the dryer may be hundreds of yards wide, so long as the depth is shallow enough to be reachable.

What occurred to you while you were asembling your dryer? How would you improve the design? What short cuts would you advise? What substitutions did you make? How did they work? Use the space below to send us these sorts of comments. They will be invaluable for future users of this manual. Tear out this sheet and send to: The New Mexico Solar Energy Association, P. O. Box 2004, Santa Fe, New Mexico 87501.

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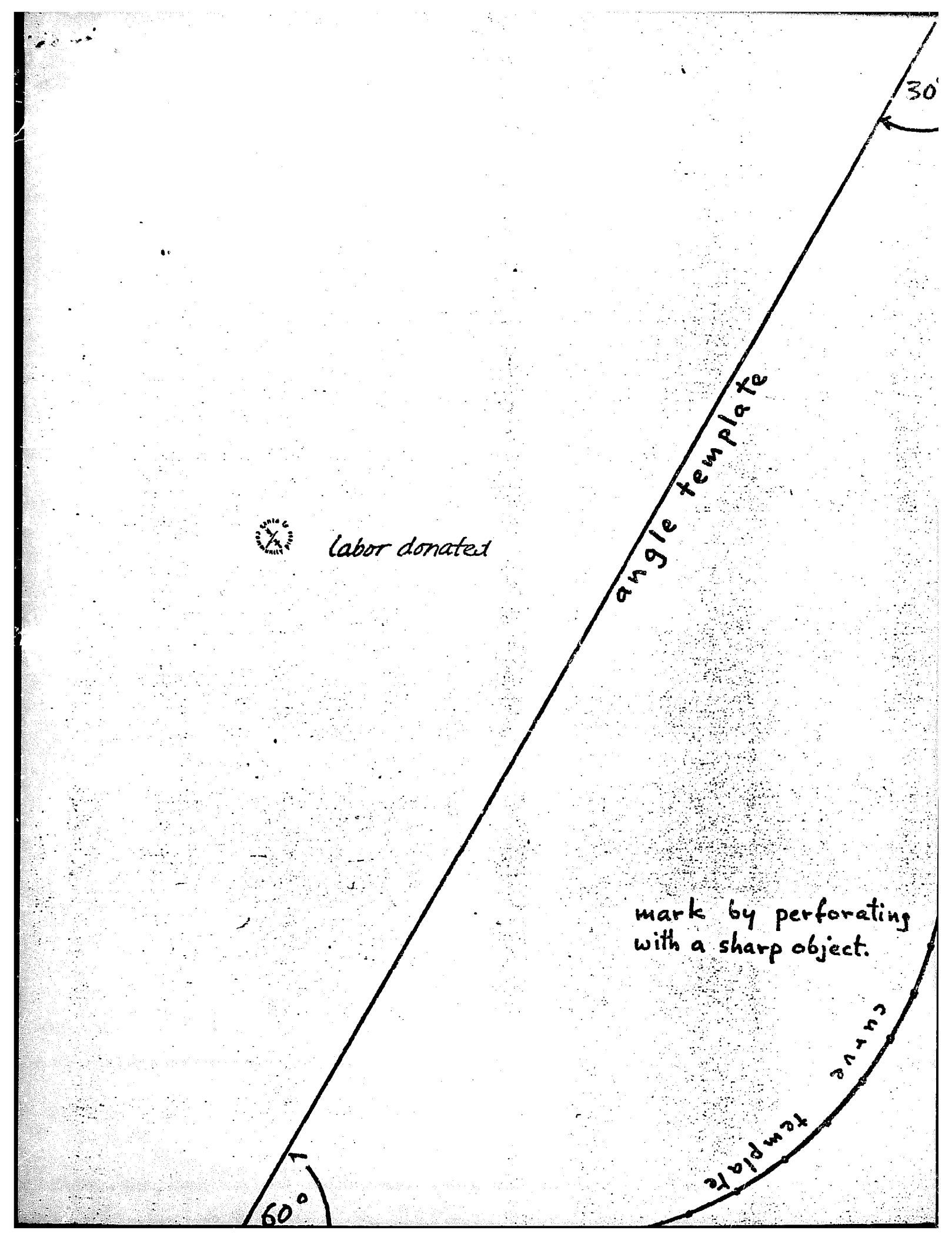
Address _____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